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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)								DATE February 2000	
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602105A Materials Technology					
COST (In Thousands)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	12867	16266	11557	14385	14865	14791	15357	Continuing	Continuing
AHM1 Hardened Materials	2890	0	0	0	0	0	0	0	5791
AH84 Materials	9977	16266	11557	14385	14865	14791	15357	Continuing	Continuing

A. Mission Description and Justification: This program element (PE) provides materials technology for armor and armaments to enable US dominance in future conflicts across a full spectrum of threats in a global context. Project AH84 is directed toward developing materials technology that will make our heavy forces lighter and more deployable, and our light forces more lethal and survivable. It provides the technology base required for solving materials-related problems in individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles and combat support. Technology for advanced materials will enable the Future Combat Systems' (FCS) survivability and lethality. Project HM1 focuses on developing the materials technology needed so that future strategic missile interceptors can meet stringent performance demands. Work in this program element has been coordinated with the other military services through the Materials/Processes Area Plan to prevent duplication of effort and to maximize the return on investment. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI.

B. Program Change Summary	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (<u>FY 2000/2001</u> PB)	13012	13849	13825
Appropriated Value	13137	16349	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-125		
b. SBIR / STTR	-93		
c. Omnibus or Other Above Threshold Reductions		-29	
d. Below Threshold Reprogramming			
e. Rescissions	-52	-54	
Adjustments to Budget Years Since (<u>FY 2000/2001</u> PB)			-968
New Army Transformation Adjustment		TBD	-1300
Current Budget Submit (<u>FY 2001</u> PB)	12867	16266	11557

Change Summary Explanation: Funding – FY 01: Project AH84 was adjusted to reflect the new Army Transformation.

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602105A Materials Technology				PROJECT AHM1	
COST <i>(In Thousands)</i>	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AHM1 Hardened Materials	2890	0	0	0	0	0	0	0	5791

Mission Description and Justification: This was a one-year Congressionally Funded program. This project focused on providing the materials technology for critical components meeting the stringent requirements of strategic interceptors. Materials optimizing for the advanced composite shroud (ACS) enables expansion of the battle space for strategic interceptors by allowing systems to be flown at conditions 3 times more stringent than the current state of the art. This technology program was managed by the Army Research Laboratory, Aberdeen Proving Ground, MD, with contractual efforts at Fiber Materials, Incorporated, of Biddeford, ME (prime), and included as subcontractors Crystal Systems, Inc., of Salem, MD, and Lockheed/Martin Corp., of Sunnyvale, CA.

FY 1999 Accomplishments:

- 2890 - Completed a successful flight test of the advanced composite shroud and transitioned to the Ballistic Missile Defense Office (BMDO).
 - Completed the documentation of failure modes for single crystal sapphire systems.
 - Completed the characterization of candidate resin systems for use in single matrix system for shroud/heat shield.

Total 2890

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

Project AHM1
Page 2 of 5 Pages
Exhibit R-2A (PE 0602105A)

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COST (In Thousands)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH84 Materials	9977	16266	11557	14385	14865	14791	15357	Continuing	Continuing

Mission Description and Justification: This project supports the Army Vision by providing the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable future Army systems that are lighter, more deployable, and more sustainable, including the Future Combat Systems (FCS). It also provides the technology base required for solving materials-related problems in individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles and combat support. Applied research efforts are focused in armor/armament materials, as well as lightweight structural materials and materials affording protection against chemical, biological, or directed energy threats. Areas of study in these developments are in characterization, to include high strain rate characterization, processing, and fabrication of these materials. Additional efforts provide materials solutions for improved performance, durability, and cost reduction in Army unique systems. The work is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD and Hampton, VA and provides required technologies for advanced development programs at the Armaments Research, Development and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center, Warren, MI; the Aviation Research, Development and Engineering Center, Huntsville, AL; the Natick Research, Development and Engineering Center, Natick, MA; and the Missile Research, Development and Engineering Center, Huntsville, AL.

FY 1999 Accomplishments:

- 6536 - Determined dynamic properties of armor grade ceramics (Al₂O₃, SiC, B₄C) and advanced composite materials (KM2, Spectra Shield, GRP); demonstrated personnel armor system with 40% weight savings over Ranger Body Armor; transitioned to Natick Soldier Center (SBCCOM).
 - Provided advanced polymeric/barrier materials that offer improved performance and durability in Army chemical defense applications.
 - Characterized processing/microstructure/property relationships of nanostructured polymers and nano-reinforced ceramic materials for improved survivability in Army systems.
 - Devised computer models that determine the structural as well as ballistic performance of complex composite material systems for application to the family of future lightweight combat vehicles.
 - Optimized process for fabricating ballistically resistant hybrid laminate.
 - Provided rapid prototyping of ballistically tolerant novel components via laser processing.
 - Quantified ballistic enhancement in integral ceramic/composite armor; demonstrated armor configuration with improved ballistic performance.
 - Characterized and elucidated processing and microstructural relationships to produce novel metallics, ceramics and intermetallic microstructures for engineering lightweight structural armor materials.
- 2802 - Characterized, in simulated gun firings, the enhanced erosion resistance of advanced coating systems designed to significantly increase gun barrel lifetime.
 - Exhibited improved ferroelectric ceramic processing using double doping to reduce losses and increase tunability for significantly reducing the cost and weight of future antenna systems.

Project AH84 Page 3 of 5 Pages Exhibit R-2A (PE 0602105A)

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<p align="center">- Fabricated prototype refractory metal shaped charged liners and verified their processibility.</p> <p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> 639 - Devised processing techniques for fabrication of nano-materials to replace depleted uranium in penetrators. 639 - Investigated fatigue, flaw detection, and material characterization of thick composite structures; and completed correlation of analytical model of smart material 'Thunder' with dynamic test results. 639 - Applied microwave non-destructive evaluation (NDE) and laser ultrasound system to detect and calibrate damage in ceramic and polymer composite structural panels, incorporated dynamic data into smart materials model; completed tests of active suspension system control for ground vehicles. <p>Total 9977</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> 8489 - Devise life prediction models for Army materiel based on accelerated weathering, cyclic corrosion testing, and real-world exposure studies that will significantly reduce logistical costs for Army systems. 8489 - Quantify and optimize sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats. 8489 - Fabricate and evaluate new mass-efficient means to improve the ballistic resistance of ceramics by integrating them with organic-matrix composites to enable improved lightweight combat vehicles. 8489 - Determine the microstructural influences of metallic-intermetallic-ceramic components on the performance of current composite armor designs 8489 - Determine high strain-rate behavior and failure criteria of layered and functionally graded ceramics, metals and anisotropic composites to develop constitutive models to abet the rational design of materials for high-performance, integrated, multifunctional armors 3200 - Devise atomic scale, physical-based models of propellant gas interactions with the gun bore surface to predict the durability of the bore surface for a variety of coatings systems and propellants. 3200 - Show that dielectric materials for miniature smart munition antenna sections will enable extended range and improved accuracy for both direct and indirect fire weaponry. 3200 - Fabricate refractory metal explosively formed projectile liners and determine their processibility. 703 - Conduct microwave NDE measurement and analyses for large composite structures; develop more portable and field usable laser ultrasonic inspection technique; and evaluate an advanced off-road, high-speed wheeled testbed, for structural dynamics research; Conduct tests of TACOM selected tire for characterization in vehicle modeling. 1185 - Determine critical materials technologies essential for the successful testing of pulsed power machines for Army After 2010. 2500 - Investigate contour weaving and braiding techniques for lightweight, affordable, reduced signature, composite structures for air and ground vehicles. 2500 - Characterize high strength and high stiffness moldable resins according to mechanical, thermal, electrical and/or optical properties. 189 Small Business Innovative Research/Small Business Technology Transfer Programs (SBIR/STTR) <p>Total 16266</p> <p>Project AH84</p>		

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<p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> <div> <div>8632</div> <div> - Provide reduced-cost, appropriate-quality processing technology for lightweight combat vehicles that feature the integrated armor structure technologies available. - Devise procedures for producing bulk materials with nano-scaled microstructures for protection from extreme environments. - Model and engineer candidate multi-phase functionally graded microstructure for penetration resistance and minimal collateral damage in future lightweight combat vehicles. - Integrate multifunctional sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats. - Validate penetration and structural simulations to enable material design for future multifunctional, high-performance armor/structure solutions to counter medium-caliber and residual (post APS) large-caliber threats to future combat vehicles. </div> </div> <div> <div>2184</div> <div> - Produce a full scale section of a large caliber gun tube coated with an enhanced erosion resistant refractory metal coating applied by high velocity spray techniques. - Evaluate thin film phase shifter materials with properties comparable to bulk materials to significantly reduce the cost and weight of future antenna systems. </div> </div> <div> <div>741</div> <div> - Provide structural dynamic response improvements with active control technology on an advanced off-road, high-speed wheeled testbed; Evaluate prototype microwave NDE hardware using TACOM-provided composite test components; demonstrate laser ultrasonic inspection technology development and checkout. </div> </div> <p>Total 11557</p>		
Project AH84	Page 5 of 5 Pages	Exhibit R-2A (PE 0602105A)